Multiple Choice Questions

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1. Relationship between wave vector and wavelength is
   $K = \frac{2\pi}{\lambda}$
2. Relationship between wave vector and momentum
   (a) $K = \frac{p}{\hbar}$
   (b) $p = \frac{hK}{2\pi}$
   (c) Both a and b
   (d) None of the above
3. For a non-dispersive optical medium, which of the following is true?
   (a) $v_g = v_p$, where v_g is the group velocity and v_p is the phase velocity
   (b) $\frac{dn}{d\lambda} = 0$, where n is the refractive index and λ is the wavelength.
   (c) Light should be monochromatic.
   (d) All the above.
4. Which of the following is true?
   (a) $v_g < v_p$ is normal dispersion
   (b) $v_g > v_p$ is anomalous dispersion
   (c) Both a and b
   (d) neither a nor b
5. Relationship between phase velocity and group velocity is given by
   $v_g = v_p - \lambda \frac{dv_p}{d\lambda}$
6. Which of the following is true?
   (a) Dual character of a physical entity can exhibited simultaneously
   (b) Only one character is exhibited at a time
   (c) Exhibition of a particular character depends on whether the entity is interacting or non-interacting with other entities.

(d) Dual character is exhibited at quantum level.

7. Which of the following is correct?

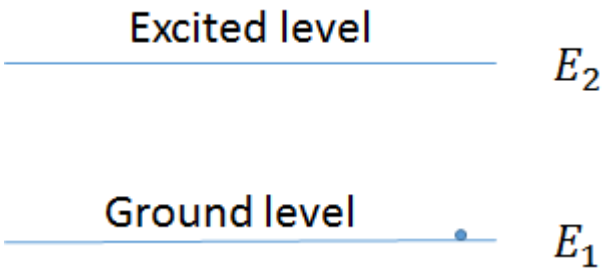
   (a) The phenomenon of interference is used for reconstruction of a holograph.

   (b) Holography produce both real and virtual images.

   (c) Diffraction is used to encode a film in holography

   (d) Holograph is a wave phenomena.

8. Which of the following is possible in a two level system which is depicted in the figure?



   (a) $E_1 > E_2$

   (b) $E_1 + E_2 = 2h\nu$

   (c) $E_2 = E_1 + h\nu$

   (d) $E_1 - h\nu = 0$

9. Which process is represented by the possible expression in question no. 8

   (a) Emission of photons

   (b) Lasing

   (c) Photoelectric emission

   (d) None of the above

10. An incoming light to an atomic system may induce

   (a) Emission

   (b) Absorption

   (c) Both (a) and (b)

(d) None of the above.

11. Which of the following is true?

    (a) The pumping mechanism is He-Ne Laser is electric discharge
    (b) Cavity in a laser system is used to build up the intensity of light.
    (c) Laser light can be only pulsed form.
    (d) None of the above.

12. For lasing action to be taken place, which of the following is the most necessary process?

    (a) Absorption
    (b) Stimulated emission
    (c) Spontaneous emission
    (d) induced emission
    (e) All the above
    (f) Both (b) and (c)

13. Which of the following statement is correct?

    (a) Population inversion cannot be achieved in a two level system
    (b) Saturation level can be achieved in a three level system.
    (c) Both (a) and (b)
    (d) Neither (a) nor (b)
    (e) All are wrong

14. The output lines of He-Ne Laser is(are)

    (a) 3.39μm
    (b) 0.6328 μm
    (c) 2.9 μm
    (d) All the above

15. Which of the following is correct?

    (a) The probability of emission and the probability of absorption are equal.
    (b) Einstein's coefficients of emission and Einstein's coefficients of absorption are equal.

(c) Einstein's coefficient of absorption is equal to Einstein's coefficient of stimulated emission.

(d) None of the above.

16. If $E_1 = E_2$, then the state is called

(a) Normal population

(b) Population inversion

(c) Saturation level

(d) None of the above

17. Which of the following is not a characteristic of LASER?

(a) Polychromatic

(b) Coherent

(c) Directionality

(d) None of the above

18. Life time of a metastable state is

(a) 10^{-3}

(b) 10^{-6}

(c) 10^{-9}

(d) 0

19. He-Ne Laser is

(a) a Solid state laser

(b) a four level laser

(c) Helium and Neodymium are the active medium.

(d) He atoms provides energy levels for laser transitions.

(e) All the above.

20. Which of the following type of Lasers uses electrical discharge as pumping mechanism.

(a) Semiconductor laser

(b) He-Ne Laser

(c) YAG Laser

(d) All the above

21. Holography was invented by

    (a) Narinder Singh Kampani
    (b) Dennis Gabor
    (c) Albert Einstein
    (d) Raman

22. Holograph records

    (a) Intensity
    (b) Amplitude
    (c) Intensity and amplitude
    (d) Phase

23. Which of the following is correct?

    (a) A meta stable state is having half lime time than excited state.
    (b) A meta stable state is having shorter life time than ground state.
    (c) A meta stable state is having longer life time than excited state
    (d) All are correct

24. Which of the following is the active medium in Nd-YAG laser?

    (a) Nd^{3+} and $Y_2Al_5O_{12}$
    (b) Yttrium Aluminum Gas
    (c) Yttrium Aluminum Garnet
    (d) None of the above

25. For a charge free density

    (a) $\nabla.\vec{E} = 0$
    (b) $\nabla^2 V = 0$
    (c) $\nabla.D = 0$
    (d) All the above.

26. The condition for a fiber to be single moded is

    (a) It should have a smaller diameter
    (b) V$>$ 2.405
    (c) V$<$ 2.405

27. The Poisson equation for an electric field in a charge free region is equal to

28. What is the output wavelength of Nd: YAG Laser?

29. In Green's theorem

    (a) A double integral is reduced into a line integral.
    (b) A line integral is converted into double integral.
    (c) The dimension of integral is reduced by one from double integral.

30. Stoke's theorem relates

    (a) A line integral and double integral
    (b) Line integral and surface integral.
    (c) The dimension of integral is reduced by one from double integral.

31. Gauss law is given by

    (a) $\int_S \vec{E}.d\vec{a} = \frac{Q}{\epsilon_0}$
    (b) $\nabla.\vec{E} = \frac{\rho}{\epsilon_0}$
    (c) $\nabla.\vec{D} = 0$
    (d) All the above.

32. The number of modes in a fiber are inversely proportional to

    (a) Wavelength of the propagating light
    (b) Frequency of the propagating light
    (c) Diameter of the core
    (d) All the above

33. The gradient vector of a scalar function ($\nabla.\phi$) is

    (a) Parallel to the surface
    (b) Perpendicular to the surface
    (c) At any angle with surface
    (d) None of the above

34. The unit of ***Curl*** is

35. The condition for a function F to be satisfied by the Laplace equation is

    (a) $\nabla.F = 0$
    (b) $\nabla^2 F = 0$
    (c) $\nabla^2 F = -\frac{\rho}{\epsilon_0}$

36. Who invented optical fiber?

    (a) Bangla Sriman

(b) Meetkumar

(c) Irshad Ahamed

(d) Yash Padharia

37. If the curl of a vector field $\vec{F}$ is zero, then $\vec{F}$ is

(a) Conservative

(b) Must be a gradient of scalar field.

(c) Irrotational

(d) Solenoidal

38. The geometry of path made by light propagating in a step index fiber is

(a) Helical

(b) straight line

(c) Zig-zag

(d) None of the above

39. The number of modes in a step index fiber can be calculated using V parameter as

40. $\nabla.f = 0$ represents

(a) Solenoidal

(b) Irrotational

(c) Conservative

(d) None of the above

41. Divergence of electric field is

(a) $-\frac{\rho}{\epsilon_0}$

(b) Zero

(c) $\frac{\rho}{\epsilon_0}$

(d) Charge density

42. The unit of dielectric constant is

(a) Zero

(b) No unit

(c) Unit of capacitance

(d) C/m^2

43. The unit of permittivity is

(a) Unit of dielectric constant

(b) No unit

(c) Farad/meter

(d) C^2/Nm^2

44. The unit of relative permittivity

(a) Zero

(b) No unit

(c) C/m^2

(d) C^2/m^2

45. Optical fiber operates on the principle of
(a) Total internal reflection (b) Piezo-electric effect (c) Photo-electric effect
(d) Holography technique

Answers

1.

2. c

3. a and b

4. c

5.

6. b, c, d

7. b. Interference is used to encode a holograph and diffraction is used to decode a holograph.

   Holograph is an object which is similar to *negative* in photograph. It is not a phenomenon.

8. c

9. d. Absorption can take place.

10. c

11. a and b. Check pumping mechanism in other type of lasers.
    Laser can be in continuous form also.

12. c and d. Both are same.

13. c

14. a and b. $1.15\mu m$ is also there.

15. a and c

16. d

17. a

18.

19. b.
    Mixture of He and Ne in the ration of 10:1 is the active medium. (Check the active medium for other laser systems). This is a gaseous laser. (Check other laser systems). Ne atoms provide energy levels while He atoms provide excitation energy.

20. b

21. b

22. Intensity and phase. (Intensity and amplitude are similar.)

23. b and c

24. a

25. d

26. c

27. 0

28. 1064 (near infrared (IR))

29. All are correct
    Green's theorem relates the double integral of a ***plane*** with the line integral of the cure that encloses the same plane.

30. All are correct.
    The difference between Green's theorem and Stoke's theorem:
    Green's theorem concerns with a surface of plane and Stoke's theorem concerns with a surface of a curved region.

31. A and B

32. A

    $V = \frac{2\pi a}{\lambda} NA$
    a$\rightarrow$ diameter of core
    $\lambda \rightarrow$ wavelength
    NA$\rightarrow$ Numerical aperture

33. A

34. Curl is not a physical quantity.

35. B

36. None of the above. (Hope they will do)
    Laser - Theodore H. Maiman
    Fiber- Narinder Singh Kapany
    Holography-Dennis Gabor

37. A, B, C

38. B and C
    For graded index fiber, it is helical or straight line (specific case)

39. $M_s = \frac{V^2}{2}$
    The number of modes in a graded index fiber is $M_g = \frac{V^4}{2}$

40. D
    Uniform scalar field.

41. C
    Divergence of a magnetic field is zero.

42. B

43. C and D

44. B

45. A